Homeowner Barriers and Options in the Renewable Energy Market:

An assessment of public and private institutions working for and against sustainable homes

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Introduction

> *My own instinct is that changes in values frequently follow changes in technology. The larger hope here is that the very act of addressing the climate crisis in its true proportions would bring home to everyone around the world the realization that we are living on a planet with limits – and that we are bumping up against those limits.* – Ross Gelbspan[1]

The great paradox of global climate change is that the energy choices made by our society are actually the cause of the imminent threat that we now face. We cannot sustain this lifestyle of presumed inconsequential energy use indefinitely. While our consumption should theoretically be limited by our resources, the limits of these resources and our planet are continually stressed through unbounded energy use. Our current power supply has a precarious future. Not only are global fuel reserves being rapidly depleted, but the rising demand and falling supply brings higher and higher prices, as well as increased emissions of greenhouse gases which exacerbate the effects of global warming. Renewable energy (RE) power generation through solar PV arrays, wind turbines or other methods serve to lessen contributions to the growing arsenal of greenhouse gases emitted from non-renewable sources such as coal and oil. Bringing energy production into the home provides us with the opportunity to rethink our energy choices and effectively change our lifestyles with the consequences of global climate change in mind. By allowing homeowners to test their own limits of energy production and consumption, RE systems make the limits of our environment an upfront reality everyday. Not until people understand the impacts of consumption, and that it is something they can change without negatively impacting their quality of life, will the impending threat caused by our energy (supply) choices lessen. Personal RE systems will reduce this risk with the benefits of being an environmentally friendly, low impact way to produce energy.

Renewable systems can either be connected to the grid, or entirely off grid. While this affects the various components of a system, in the end any devices can be applied on or off grid depending on the suitability of the site for the particular product. There are a number of reasons why one may choose to live "off-grid," completely unattached to the utility electrical supply. Energy independence has an appeal to some, as does the idea that personal energy use has no adverse effects on the environment. Another incentive is cost. In many remote areas, it is more cost effective to build an independent power system than to pay to bring in the power lines. Independent systems produce power, store excess energy in battery banks, and supply power to all electrical devices in the home. When the batteries are fully charged, any power beyond what is being used as it is produced is lost. In off-grid homes, it is necessary to monitor power use, because consumption beyond the means of the system (dependent on weather conditions) can leave a home without power. To avoid this, many off-grid homes will have a backup generator.

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[1] Ross Gelbspan, *Boiling Point: How Politicians, Big Oil and Coal, Journalists, and Activists Have Fueled the Climate Crisis – And What We Can Do to Avert Disaster* (New York: Basic Books, 2004), 200.

It is also possible to be connected to utility power and run entirely or partially off of personal RE systems. Grid-tied systems can work in two ways: through net metering or having a system with batteries, but also connected to the grid. Both types can effectively turn the meter back to reduce electric bills. Net metering is the term applied in situations when unused power is sold back into the grid to be used by someone else. A home's power supply comes first from their personal production, but in the event that personal sources are insufficient, power is drawn from the grid. Net metering laws vary from state to state, ranging from the more favorable option where the power company pays the individuals for their excess power, to less favorable where the usage is done on a monthly basis.

In contrast to home energy production, electricity generated by power utilities perpetuates an out of sight, out of mind mentality regarding the consequences of energy consumption. Over half of our nation's electricity supply is produced using non-renewable, hydrocarbon resources, specifically coal, oil and natural gas (Figure 1, Appendix A).[2] The burning of these fuels by power utility plants contributes significant amounts of greenhouse gases every year, which electricity consumers do not see firsthand.

The resulting effects of global climate change will be felt for years to come by many people, not just American electricity consumers. As evidenced in the August 2003

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[2] National Energy Policy Development Group, *National Energy Policy* (Washington, DC: Office of the Vice President, May 2001) xiii, http://www.whitehouse.gov/energy/Overview.pdf, accessed 12/14/04.

Northeast Blackout, the power grid through which utility power is generated is vulnerable to massive power failures. By having the source of power generation in one's backyard, RE technologies provide individuals with the opportunity to decrease their contributions of greenhouse gases and to increase their home energy security.

While early use of alternative energy sources declined with rising energy demand in the early 20th century, RE systems were revived in response to energy security concerns that arose during the 1974 Arab Oil Embargo.[3] The oil shortages of the 1970s created an environment that was more open to RE, and the Carter Administration "gambled heavily" with RE through subsidized research and development, and tax breaks for homeowners and companies who used RE. However, in the end solar and wind power gained a bad reputation in the US due to incorrectly installed systems. Advances in RE technology did not begin again until the mid 1990's as Japan and Europe began to acknowledge the consequences of burning fossil fuels, and encouraged RE in homes through various government initiatives. The resulting increased volume in sales allowed companies to invest more money in improving technology and lower manufacturing costs.[4] As technology improves, and the demand for RE devices rises, these costs continue to decline.

Overseas trends in RE power generation have not caught on throughout the United States, but Vermont is an example of a state where RE exploration has been encouraged for both utility companies and homeowners. In the last 30 years since energy security first became a national concern, Vermont has provided homeowners with opportunities to address environmental concerns and security issues related to energy consumption through incentive programs and tax credits. Now more than ever, homeowners can contribute to increasing Vermont's energy security. The contracts of Vermont's two biggest energy suppliers, Vermont Yankee nuclear power plant and Hydro Quebec, are due to expire within the next 15 years (Figure 2, Appendix A).[5] With the end of these contracts looming on the horizon and increasing electricity consumption, the state government and Vermont citizens need to begin thinking about where electricity will come from in the future, and what the environmental impacts of electricity production will be. Wind use in Vermont has been the subject of recent public debate. A wind electrical plant is located in Searsburg, and proposals for similar wind farms exist elsewhere in the state. While wind farms are one option for renewable, utility power production, smaller independent or grid linked systems are a better option because they allow people to see where their power comes from and promotes a greater understanding and awareness of their energy consumption. In order for homeowners to tackle these issues in their own backyard, several barriers that currently stand in the way of home RE power generation need to be overcome.

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[3] Dodge, Darrell M, *Illustrated History of Wind Power Development* (Littleton, Colorado: Telos Net Web Development: http://telosnet.com/wind/ November 11, 2004); Paul Roberts *The End of Oil: On the Edge of a Perilous New World* (New York: Houghton Mifflin Company, 2004), 3.

[4] Roberts, 193-195.

[5] Azur Moulaert & Drew Hudson, *Clean Energy for Vermont: A Plan Today for Tomorrow* (Montpelier, Vermont: Vermont Public Interest Research and Education Fund, 2004) 12,

Those inclined to make their homes self-sufficient often face conflicts along the road to sustainable energy production, from fighting with neighbors to discriminatory national mortgage standards. These obstacles also apply when one is trying to buy a home with RE technology. Our research was primary conducted by consulting people familiar with renewable energy technology in residential homes. We spoke to banks and mortgage brokers about financing, green builders as well as more traditional builders about their perceived market demand in new construction, RE installers about the market and what they see to be the hindrances, planning officials about current zoning regulations concerning RE, as well as several owners of RE homes. From this, we came to the realization that although Vermont is often perceived as a “green” state, there are still inherent barriers in the renewable energy incorporation process that make it more difficult to have RE systems than a standard utility power. In this report, we attempt to introduce some of these barriers we have come to recognize, look at the background of the institutions to determine the roots of these problems, and make suggestions as to how legislators, renewable energy advocates, and homeowners can work together to overcome these barriers, helping to streamline the process and make sustainable homes more abundant and desirable. This document is accompanied by a list of the top ten things RE inclined homeowners should know (Appendix B).

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http://www.vpirg.org/downloads/2004.08.27_Clean_Energy_for_Vermont_final_version.pdf, accessed 12/14/04.

Part I: Financing

Personal RE systems allow consumers to lower their energy costs, paying more up front, but in the long run, saving money while doing something good for the environment. Unfortunately, making the commitment to energy independence is not as easy as it should be. Buying a home with a completely or even partially independent, renewable power supply can be more difficult than buying another home. After taking a deeper look at mortgages and home equity loans, it became apparent that the problem stems from the nature of the market, which assesses value using a system of comparisons. When buying a home, getting a mortgage is often a primary concern, so it is a big problem that mortgages for renewable homes are harder to get. The mortgage process can also hinder the ability of homeowner's who convert their homes to renewable energy from selling the house in the future, if it cannot be adequately financed for the buyer. Ideally, banks and other lenders should develop options accommodating to RE.

The Mortgage Market

The mortgage market is complicated, and like any financial institution, the goal of lenders is to make a profit. Lenders are either institutional (commercial banks, savings and loans, credit unions, mortgage banking companies, pension funds, insurance companies, etc.) and federally regulated or private (individuals or small companies) and generally unregulated and without insured depositors. Both deal within the primary and secondary market. Banks and other mortgage companies are either mortgage bankers or brokers. Mortgage bankers are direct lenders, lending their own money. Mortgage brokers are middlemen, shopping around for their borrowers. They often deal with lenders who do not work directly with the public, and have connections to hundreds of lenders nationwide. It is common for primary lenders to sell packages of mortgages to secondary market investors, which replenishes their funding, allowing them to lend further. In any case where the loans are sold on the secondary market, the bank or lender cannot offer a loan to a property that doesn't fit the guidelines of the secondary buyer they wish to sell it to. On the secondary market the three largest buyers are the Federal National Mortgage Association (FNMA or "Fannie Mae"), the Government National Mortgage Association (GNMA or "Ginnie Mae") and the Federal Home Loan Mortgage Corporation (FHLMC or "Freddie Mac"). The fact that there are only three main lenders puts the power predominantly in their hands. Banks and other mortgage companies only have the option of which secondary lender to do business with. Unless they have the ability to maintain the loans themselves, which some banks do, banks cannot act entirely on their own prerogative.

If a home does not adhere to these guidelines, investors view it as a risk, making it unlikely that they will "buy" the loan from the bank. The label of risk applies to properties other than those with RE systems, such as homes with composting toilets, camps without municipal water, and self-contained septic systems – anything different for that geographic region. This region is defined through the market system of appraisals and comparables. One such guideline in terms of appraisals is that they must be able to find three similar homes to compare it with. This is often within a certain radius, but with unique homes, the radius is variable.[6] In general, two-story colonials cannot be appraised based on three ranches, but in the case of unique homes, exceptions are made. However, in terms of RE, comparable properties must have the same power setup as the property in question.[7] Off-grid homes and homes that incorporate solar, wind or any other non-conventional energy sources in even small ways are unique. Usually, there are not three similar homes even relatively nearby making a standard loan hard to obtain.

In the end, it all comes down to money and market value. Investors cannot use their standard appraisal and comparison methods to determine the market value of an RE property. Since appraisers cannot accurately assess resale value, the concern arises that should the investors have to seize the property, they might have a harder time selling it, and run the risk of losing rather than gaining money on their investment. If investors do take on "risky" loans, they often want to know what the cost would be to add mainstream power, just in case they have to foreclose, as they see grid connection as increasing their resale potential.[8] This is a reflection of societal values and short-term thinking. While RE could be deemed an asset to a home, increasing the resale value and potential, the label of risky is instead applied simply because RE homes are different.

The general consensus seems that if there were more properties with solar water heaters or similar RE devices, investors would be able to do their regular appraising and comparables, and offer standard loans.[9] While this would not solve the problem of worth associated with such systems, it would at least make standard mortgages attainable. These homes should not be harder to sell than any other, but changes need to happen on a national level before they lose the label of being "risky." As there are plenty of "normal" homes that need financing, there is not a push in the financial sector to support independent systems. Even when financing is available, there are often more stipulations and higher interest rates. One such stipulation is the Loan to Value (LTV) ratio, which is the percentage of the overall worth of the property that a bank is willing to lend. The LTV acceptable on unique homes is lower, requiring a larger down payment.[10] When these homes become "mainstream," the market will follow suit.

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[6] Mark O'Connell. Statewide Mortgage Assistance (personal communication, November 16, 2004).

[7] Michelle Shambo, Chittenden Bank (personal communication, October 26, 2004).

[8] Mark O'Connell, Statewide Mortgage Assistance (personal communication, November 16, 2004).

The "risky" mindset slowly seems to be changing in the financial world. At the local level, Vermont's Chittenden Bank is starting to view these loans as more secure due to the increased stipulations (lower LTV) despite that these borrowers do not have bad credit of a decreased willingness or ability to pay, but they are the minority and the mindset that renewable energy is seen as "risky" is still unfortunately a major deterrent in securing a mortgage.[11] In a conversation held with Michelle Shambo, a Mortgage Loan Officer at the Middlebury branch of Chittenden Bank, she described a mortgage request she was currently processing. In this case, the borrower was denied a standard mortgage because solar turned up on the appraisal form, which must be completed before a mortgage will be issued. The house had utility power, a gas furnace, and a seemingly standard hot water and energy system, except it said "solar" somewhere else on the form, with no explanation of how this was incorporated. In any case, despite being an otherwise standard house, the requestor could not get a mortgage.[12] She was in the process of assessing the other options available for this particular home.

What are some of the options?

There are banks throughout the nation that offer mortgages on renewable energy homes, but financing to help buy these systems seem to be more readily available. This indicates a gap in the financial sector. Initially, they are willing to help finance the cost of these devices, but if the person chooses to move, the next owner of the same system will have trouble finding financing. The California Energy Commission has a list of financing options. None of the institutions on the list are banks, but there are a number of mortgage companies that offer mortgages on residential properties with renewable systems. While some specify solar, or have other limitations, others are for any type of system.[13] In the UK, the Ecology Building Society promotes sustainable housing and communities, and was established to provide mortgages for properties that have an ecological payback. They lend in England, Scotland, Wales and Northern Ireland, and fund energy efficient housing, ecological renovation, derelict and dilapidated properties, small-scale and ecological enterprise and low-impact lifestyles, renewable energy homes as well as other properties with hard to place financing.[14] In general, financial institutions seem more willing to finance efficiency measures than renewable systems, and the Ecology Building Society appears to be a rare exception, but the type of financial group that would ideally become established world wide, filling the much needed void of programs giving special allowances to renewable options.

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[9] Michelle Shambo, Chittenden Bank (personal communication, October 26, 2004); Mark O'Connell. Statewide Mortgage Assistance (personal communication, November 16, 2004).

[10] Mark O'Connell, Statewide Mortgage Assistance (personal communication, November 16, 2004).

[11] Cynthia Gubb, Chittenden Bank (personal communication, November 8, 2004).

[12] Michelle Shambo, Chittenden Bank (personal communication, October 26, 2004).

At the national level, some secondary lenders have programs that mildly accommodate some RE technology but are more accommodating to efficiency measures. After contacting many major banks in Vermont, as well as a few mortgage companies, it was determined that that most use national lenders and thus do not set their own guidelines. Fortunately though, buying a home in Vermont with RE technology does not eliminate all prospects for getting a mortgage. The only programs regarding RE homes in Vermont we learned about are those offered by Chittenden Bank and Merchants Bank. However, there are potentially others in smaller banks that cater to their local community instead of the entire state. Mortgage companies finance through an array of lenders nationwide. While it is harder for them to cite specific options for RE, it is often possible for them to find options for RE homes as well as other unique properties.[15] Despite the limited options, some banks are mindful of the energy interests of their clients. Investigating several mortgage companies may allow RE inclined homeowners to take advantage of options outside of those offered in state.

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[13] California Energy Commission, "List of additional companies financing solar, wind and other energy systems." (http://www.consumerenergycenter.org/erprebate/financial_companies.html, accessed December 3, 2004).

[14] Ecology Building Society (www.ecology.co.uk, accessed December 15, 2004).

[15] Mark O'Connell, Statewide Mortgage Assistance (personal communication, November 16, 2004).

From the National Secondary Market

Fannie Mae is the nation's largest source of mortgage funds. Congressionally chartered and shareholder owned, they are willing to buy and sell certain energy efficient and traditional mortgages on the secondary market. As part of the "Showing America a New Way Home" initiative starting in March 1994, they began partnering with utility companies to assist customers by providing low-interest, unsecured consumer loans for the purpose of installing residential energy efficiency improvements.[16] The Residential Energy Efficiency Improvement Loan program provides below market interest rates on loans for the purpose of efficiency measures. In this way, they help make it possible to add RE technology to homes. Through Fannie Mae, 100% of energy improvements can be financed up to 15% LTV for existing homes and up to 5% LTV on new homes. Loans are typically up to $15,000 for a term of up to ten years. Solar hot water and space heaters as well as PV power systems (including grid independent) are eligible under this program.[17]

Fannie Mae also has an Energy Efficient Mortgages (EEMs), taking into account that energy efficient homes cost less to operate energy-wise than standard homes. EEMs make it possible for borrowers to qualify for larger mortgages due to the fact that the money they save in efficiency makes them able to spend more on their other housing expenses. This benefits those who buy energy efficient homes as well as homes that need energy improvements. A home energy rater is used in this qualifying process.[18] Any Vermont bank that is a Fanny Mae lender should have these programs available.

Freddie Mac is another secondary lender, buying mortgages then packaging them as securities and selling them to investors, such as insurance companies and pension funds. Freddie Mac has an EEM program similar to Fannie Mae's. These mortgages tend to be up to $240,000 and run in 15, 20 or 30 year terms. These loans have a fixed rate and allow for a 95% LTV. Photovoltaic (including grid-independent) and solar thermal systems are eligible in this program, and can increase the base loan by up to 10%.[19] While these options allow some flexibility and encourage lenders to place more value on efficiency, these guidelines are more beneficial for efficiency standards than to RE systems. Due to other guidelines, homes with RE technology will not always qualify for these options.

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[16] US Department of Energy. *The Borrowers Guide to Financing Solar Energy Systems: A Federal Overview* (http://www.nrel.gov/ncpv/pdfs/26242.pdf accessed November 11, 2004).
[17] Ibid.
[18] Fannie Mae (http://www.fanniemae.com/, accessed November 9, 2004).

Local Initiatives

Chittenden Bank prides themselves in being a community responsive bank, meaning they have adjusted their banking options for the benefit of and to fit the need of the community.[20] Chittenden created their Socially Responsible Banking (SRB) system to facilitate positive change. Participants receive lower interest rates, and the result is discounted rates to a wide variety of community groups, educational institutions, small family farms, and other organizations and individuals who would otherwise not have the ability to obtain loans. Mortgages and home equity loans on homes that do not fit the standard investor criteria, such as RE, are worked into this system. Chittenden Bank feels that people with the desire to live in this environmentally responsible, sustainable way should not be at a financial disadvantage to the standard homeowner.

These mortgages require at least 80% LTV, and are a 3/1 financing system, meaning that the interest rate is fixed for the first three years, and subject to yearly change thereafter. Chittenden keeps these loans in the bank, and since they are not a large investor they cannot offer a fixed rate, which is a much more desirable financing option. Unlike other investors, Chittenden does not see these mortgages as a risk, and feels they are potentially more secure due to the low LTV. While non-conventional, these borrowers are as willing and able to pay as the standard homeowner. Chittenden also offers five-year home equity loans for energy improvements at their Advantage Plus rate (a 1% discount) and typically the best rate offered. The loan again works at an 80% LTV, with loans ranging from $10,000 to $100,000. These loans can be used for efficiency measures as well as RE devices.

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[19] US Department of Energy, *The Borrowers Guide to Financing Solar Energy Systems: A Federal Overview*. (http://www.nrel.gov/ncpv/pdfs/26242.pdf accessed November 11, 2004).

[20] Chittenden Bank, *Socially Responsible Banking* (https://www.chittenden.com/socially-responsible.html accessed October 25, 2004); Michelle Shambo, Chittenden Bank (personal communication. October - November 2004); Cynthia Grubb, Chittenden Bank (personal communication, November 8, 2004).

SRB accommodates a niche market in need of financing options, but the set up of the mortgage makes it apparent that they are still on their guard when it comes to renewable energy. The mortgage set-up makes it secure for Chittenden Bank, but it is set up this way due to the perceived risk. The 3/1 interest rate is undesirable in long term financial commitments like mortgages, and the low LTV also requires a larger down payment. The home equity loan for energy improvements shows more innovative, long-term thinking when it comes to renewable energy.

SRB is advertised at many branches throughout the state of Vermont and through their website, but the specific mortgages and home equity loans pertaining to RE technologies receive no attention. Due to the cost of advertising, and the specific niche market such options appeal to, Chittenden Bank does not feel it would be cost effective to specifically advertise the RE aspect of SRB. They rely instead on an informal referral system, telling renewable installers that they offer these programs so that their customers can be referred for financing. When speaking to installers, a number mentioned this program when asked about the barriers when it comes to financing. This shows that informal referrals through installers is getting the word out to those considering an RE system in their home. Chittenden has also sponsored events such as Solar Fest and through Renewable Energy Vermont. From their perspective, they reach more interested people by setting up tables at events such as these, and are therefore more effective in spreading the word to the people who might be inclined to take advantage of these options.[21] One downside is that the program does nothing to potentially interest people outside the small group of those already interested in RE. The fact that there are only six such mortgages in the state this year to date shows that this program is not widely utilized, but Chittenden representatives seem optimistic that as energy prices continue to rise, this market will become more desirable, causing it to grow.

Merchants Bank, also a local Vermont bank, does not have a specific program for homes with RE systems, but it is possible for buyers to receive a normal mortgage or equity loan for homes with RE technology, as long as there is at least a secondary thermostat controlled heating system. This system does not have to be in use, it just has to be present and working. Merchants Bank keeps all loans in house, so they are able to set their own guidelines. Their reasoning for requiring a secondary heat source is that renewable sources are not 100% reliable. In a place like Vermont, if the elements fail, having a secondary heat source can help avoid frozen pipes, which can cause a lot of damage to the home. As this is not a specific program, it is not advertised in terms of renewable energy. It is unclear how frequently they finance RE homes.[22]

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[21] Cynthia Gubb, Chittenden Bank (personal communication, November 8, 2004).

As previously described, the financing process can be long and challenging to homeowners wishing to bring RE technology into their homes. The fact that it is local banks rather than nation wide chains, as well as banks who keep loans in house, supports the idea that while smaller financial institutions should in theory have lesser abilities to take these financial risks, they are also the ones who care about and react to the needs of the local community. This community responsiveness is a wonderful aspect of our society, but in the end, a change in the national mortgage scene is necessary to prompt national lenders to have options beyond efficiency. The permitting process is another step in RE home development, and has its own opportunities and barriers.

Part II: Permitting

The permitting process for renewable energy technology in homes depends upon many factors, including what type of technology is being installed, individual town zoning regulations, and if the system will be net metered. After speaking with RE installers, homebuilders and homeowners that live in homes with renewable systems, it is apparent that there is no single main barrier in the zoning and permitting process. Homeowners wishing to install renewable technology have individual paths they need to follow, and there are barriers in the permitting process that can arise based on the chosen path (A diagram outlining these paths is included in Appendix B). The permitting process is generally more complex when wind towers and/or net metering are involved. Net metering application review is done through the Vermont Public Service Board because it involves selling excess power produced from RE devices to the power grid, and non-net metered RE setups are either not regulated or regulated by town zoning laws. The following discussion examines potential barriers along these two paths.

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[22] Heather Cruickshank. Merchants Bank (personal communication, November 9, 2004).

In non-net metered setups, some review of town zoning laws is necessary.[23] While few towns have zoning ordinances specific to renewable energy technology, other laws apply depending on the set up.[24] For example, setback from property lines and tower heights dictate limitations on the siting of RE system components.[25] Most towns require a building permit when a home's utility system is modified, but other than usual permitting involved with building projects, there is little language dealing specifically with RE technology.[26] More towns are taking this into consideration as their town plans are up for review.[27]

Net metering requires state approval through the Public Service Board's application for net metering, and therefore does not require review at the town level. The application and certificate of public good clearly outline the specifications necessary for using an RE system tied to the grid, including a minimum insurance policy of $100,000 to insure against problems associated with a grid connected system, such as islanding.[28] Islanding occurs when the power grid is out of service and an RE home is still producing power and sending it to the grid, thus creating an island of electricity and a dangerous situation for power company workers. This problem can be prevented through incorporation of a power converter device.[29] In Vermont, power companies will not pay homeowners for power above the property's annual usage.

Although minimal regulation can be considered as encouraging incorporation of RE technology in homes, future zoning language specific to renewables may help solve conflicts between neighbors regarding this technology, particularly in relation to wind.[30] Solar can be hidden from view and is not considered unsightly by most, but the visual impact of wind turbines raises opposition from neighbors making it harder for homeowners to receive permission to install a wind system. "Undue adverse effect" is the primary aesthetic guidance term issued by the state of Vermont thus far without an established definition, leaving it open to interpretation. Determination of visual impact is made using the Act 250 standard "Quechee test," which aims to answer the following questions:[31]

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[23] Fred Dunnington, Town of Middlebury, Town Planner (personal communication, October 29, 2004).

[24] Brandy Saxton, Addison County Regional Planning Commission, Regional Planner (personal communication, October 21, 2004).

[25] Fred Dunnington, Town of Middlebury, Town Planner (personal communication, October 29, 2004).

[26] Ibid.

[27] Ibid.

[28] Vermont Public Service Board, *Net Metering Application* (Montpelier, Vermont: Vermont Public Service Board) http://www.state.vt.us/psb/rules/5100amendedappanoheader.pdf, accessed 11/10/04; George Lawrence, The McKernon Group (personal communication, November 4, 2004).

[29] Ballard, Inc. Ecostar Power Converter Anti-Islanding Capability, http://www.ballard.com/resources/powergen/AntiIslandingCapability.pdf, accessed 12/8/04.

[30] Fred Dunnington, Town of Middlebury, Town Planner (personal communication, October 29, 2004).

- *Would the tower be shocking or offensive to the average person?*
- *Has the applicant taken reasonable steps to mitigate the adverse aesthetic impact, including reasonable siting alternatives and reasonably modest sizing?*

These questions are answered through public hearing forums, site visits, and photo simulations from key vantage points.[32] While state review is mandated for all net-metering projects through the Vermont Public Service Board, the Quechee Test is still employed for non-net metered homes on a town-by-town basis. A bill was proposed in the Vermont State Legislature to make wind turbines go through the same Act 250 process that all land development is required to go through in state, but was defeated until further studies are conducted.[33] As the wind debate in Vermont continues, more determinations and language regarding siting are likely to emerge.

The very technical nature of renewable energy technology and the permitting process prompts people to hire installers to incorporate these systems into new or existing homes. Many installers have experience with the permitting process and the technology from their own home installations, allowing them to facilitate the process for others.[34] Regardless of the work done by installers in the permitting process, resolving issues with neighbors remains the primary barrier in the RE home process. George Lawrence of the McKernon Group cited the recent debate in his town surrounding a wind turbine donated to Addison Elementary School. Concerns ranged from how the wind turbine would affect bird populations in the nearby Dead Creek Wildlife Management Area to what would happen if the turbine fell over onto the school.[35] As the general public becomes more educated about how this technology works and its overall benefits, aesthetic issues and other concerns related to RE siting will hopefully become less of a barrier.

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[31] Ibid.
[32] Ibid.
[33] Ross Sneyd, "House rejects effort to further regulate wind turbines." *Rutland Herald* (Rutland, VT: March 25, 2004): A8 (http://www.rutlandherald.com/apps/pbcs.dll/article?AID=/20040325/NEWS/403250333&SearchID=73192978247062, accessed December 14, 2004).
[34] Tom Halnon, Vermont Green Energy Systems (personal communication, October 29, 2004); Colin Kerr, Windstream Power Systems, Inc. (personal communication, October 29, 2004).
[35] George Lawrence, The McKernon Group (personal communication, November 4, 2004).

Part III: Perspectives of the Industry

Installers

In the state of Vermont, there are a wide variety of companies in the RE technology market (Appendix C). Companies run the gamut from specializing in solar or wind installation to having an array of residential systems available - from one man businesses to businesses with branches across the nation. Interestingly, a number of the smaller companies started after the founder built an off grid home, prompting them to enter the business. Numerous homes with wind turbines, solar panels and other devices exist throughout the state, creating small systems to generate power for Vermont's citizens.[36] To acquire such a device, one has only to speak to one of the various installation companies located throughout the state, who will assist in determining the best location and set up for the particular site, as well as in the permitting process.

Local Installation Companies

Many Vermont installers have been around for decades, with some beginning during the first oil crisis in the early 1970s. It is important to note that many of these business owners live off grid, and in other cases the offices are run using RE sources as well. Personally committed to the idea of RE, the common goal of these businesses is to help make sustainable energy available to Vermonters, responding to the need for reliable and cost effective products. While some companies partake in researching these technologies, others simply make them available to consumers. Both are vital to the expansion of RE use in Vermont. All installation companies spoken to consult with their customers as to what types of devices will best supply their power needs, which varies depending on energy use and property location (Appendix C).

From the perspectives of the installers, the greatest barrier comes from "bureaucratic capriciousness, as well as obstruction by people who make it their business to object to anything their neighbors, or anybody else, might want to do."[37] Another frequently mentioned issue is cost and financing. While financing can usually be resolved through previously discussed financing opportunities, it is recognizable from any of these companies' product catalogs that RE devices are still expensive. As RE items become more mainstream their cost is likely to decrease, and hopefully more homeowners will be inclined and able to afford these systems.[38] While there is no sales tax on RE devices to begin with, installers believe that other incentives will enhance the demand for these programs. Incentive programs have existed in the past, and various research is being conducted to determine the best way to obtain sustainable funding for another incentive program.[39]

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[36] ES 401 image studies website: http://f04.middlebury.edu/envs0401a/students/image_studies/.

[37] Colin Kerr, Windstream Power Systems, Inc. (personal communication, October 29, 2004).

There seems to be little or no cooperation between homebuilders and RE installers. A few installers have worked with homebuilders on isolated occasions, but none reported doing it regularly. Homebuilders have an increased interest in working with installers when off-grid systems make it possible for them to build in more remote areas.[40] Some installers think that builders "are looking to deliver their own product as simply and inexpensively as possible, and see a renewable energy system to be an unnecessary complication."[41] Installers feel that as homebuyer perceptions change, builders will become more inclined to add RE systems, but until then they will follow the market.

Homebuilder's options and barriers

One of the original questions that directed our research was why homebuilders frequently do not provide RE options to their clients. Given that small solar and wind are now mature, reliable and cost-effective technologies, why are they not incorporated as much as they could be? This question and others regarding the feasibility of RE systems in homes were posed to several homebuilders both in Vermont and out of state to learn about why solar and wind are not used in new home construction and home renovations.

The most common response to the above question is cost. When working on a fixed budget determined by their clients, homebuilders are reluctant to suggest an additional, costly system that many of their customers view as unnecessary if there is access to the grid nearby. However, if it is necessary to pay the power company upwards of $5,000 to install power lines, it may be more cost effective for homebuilders to investigate non-grid tied solar or wind systems to provide a source of electricity.[42] Despite the fact that construction of rural homes removed from the power grid is a frequent occurrence in Vermont, many homebuilders do not have the knowledge, resources, or business connections to suggest installation of an RE system to their clients, thus relying upon the often expensive "norm" of the power company.[43] Cost is the primary barrier to incorporating renewables through retrofitting electrical or heating systems in residential homes, therefore making it an unattractive option in remodeling situations.[44]

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[38] George Lawrence, The McKernon Group (personal communication, November 4, 2004).
[39] Andrea Hamre & Caitlin Prentice, *Vermont Homeowner Renewable Energy Incentives: Towards an Effective Strategy* (Middlebury, VT: ES401, 2004).
[40] Ibid.
[41] Tom Halnon, Vermont Green Energy Systems (personal communication, October 29, 2004).

Energy Efficiency

Many Vermont homebuilders are well versed in terms of building practices that maximize energy efficiency, but do not have the same level of knowledge and expertise when it comes to energy generation from renewables. On the state and national levels, there are more programs for homebuilders and customers in support of energy efficiency than for renewable energy technology. Energy Star home rating programs and Efficiency Vermont are examples of programs that have successfully educated electricity consumers about the benefits of energy conservation.[45] New homes can be built up to and beyond efficiency energy code standards, such as those provided by the Burlington Electric Department, and may become "too tight," preventing warm, humid air from leaving and cold, fresh air from coming in, resulting in stale, uncomfortable air.[46] In response, the state recently issued changes in building codes specifying allowance for air exchange to continue while maintaining efficiency standards, which can be achieved through different forms of ventilation systems such as heat recovery vents.[47]

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[42] Jamie Hutchins, Oakville Properties (personal communication, November 9, 2004); Central Vermont Public Service, *Line Extension Policy* (Rutland, Vermont: Central Vermont Public Service, September 21, 2001) http://www.cvps.com/downloads/linextsept2000.pdf, accessed 11/17/04).

[43] Jamie Hutchins, Oakville Properties (personal communication, November 9, 2004).

[44] Ed Cohen-Rosenthal et al, "Build it Right: Cleaner Energy for Better Buildings," *Renewable Energy Policy Project with American Council for an Energy-Efficient Economy Research Report 10* (Washington, DC: Renewable Energy Policy Project, March 2000): 10 (http://solstice.crest.org/repp_pubs/pdf/buildings2.pdf, accessed November 17, 2004).

[45] Department of Energy and the Environmental Protection Agency, "Energy Star Qualified New Homes," (http://energystar.gov/index.cfm?c=new_homes.hm_index, accessed November 15, 2004); Efficiency Vermont, "Residential" (http://www.efficiencyvermont.com/index.cfm?L1=158&sub=res, accessed November 15, 2004).

[46] Burlington Electric Department, "Guidelines for Energy Efficient Construction for the City of Burlington, Vermont: Burlington, Vermont Amendments to the Companion Document – International Energy Conservation Code 2000" (http://www.burlingtonelectric.com/SpecialTopics/BEEG%20Update_Amendments%20-Final%20Draft%20Nov.%208_%202000.pdf, November 13, 2000, accessed November 11, 2004); John Tenny, Mill Bridge Construction (personal communication, October 29, 2004); George Lawrence, The McKernon Group (personal communication, November 4, 2004).

Homebuilder Perspectives

While there is much information regarding energy efficiency for homebuilders from state agencies, the lack of similar information about RE technology is a barrier to more incorporation in new home construction. In addition to cost, homebuilders cited lack of home building industry knowledge about renewables and insufficient client demand as reasons for why they do not employ small solar and wind in new or renovated homes.[48] As James Vann from RA Solar Company put it, "Solar Domestic Hot water systems (DHW) cost $4000-$5000.00 and more and they offset a $20.00-$40.00 utility bill for DHW. $4,000.00 buys a hot tub, which has no payback at all. People pick the hot tub every time."[49] Many factors external to the technology itself were mentioned as additional reasons why it is not incorporated in home construction. Specific characteristics of American society were pointed out as the underlying reasons of why small wind and solar are not employed more frequently in new homes, such as lack of foresight and placing personal priorities ahead of the public good.[50] David Martin of the McKernon Group said that even though energy conservation has been in the American mindset since the energy crises of the 1970s, sustainability in relation to green design and renewable energy technology is a relatively recent phenomenon. A catch 22 develops from the lack of knowledge that homebuilders possess regarding RE and the lack of client demand for RE systems, thus maintaining the status quo.

The homebuilding industry as a whole reflects this resistance to change in their reluctance to incorporate RE technology in new construction. The decentralized nature of the building industry hinders the spread of information about advances in technology, including renewable energy technology.[51] Homebuilders have a complex set of interests and generally operate conservatively to maintain the status quo and limit their liability.[52] Recent technological developments are viewed as risky because they are not the tried and true method of power generation, and RE technology in homes may conflict with some interested parties of the home-building industry, such as power companies.[53] As John Tenny from Mill Bridge Construction said, "Builders tend to move with the marketplace," and homebuilding practices in terms of green design and efficiency reflect this, but the marketplace has not caught on to renewables just yet.[54] In a similar trend, builders tend to build to building codes, and changes in building codes could increase the amount of RE produced in homes in the future.[55] Energy efficiency codes, as previously discussed, are examples of this phenomenon as well.

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[47] George Lawrence, The McKernon Group (personal communication, November 4, 2004).

[48] George Lawrence, The McKernon Group (personal communication, November 4, 2004); John Tenny, Mill Bridge Construction (personal communication, October 29, 2004); Keith Dewey AIA, Dewey & Associates Architects & Planners (personal communication, November 11, 2004).

[49] James Vann, RA Solar Company (personal communication, November 11, 2004).

[50] Keith Dewey AIA, Dewey & Associates Architects & Planners (personal communication, November 11, 2004).

[51] Cohen-Rosenthal et al, 4.

Homebuilders think that many of their clients do not understand how the technology works and therefore feel that incorporating renewables in new or remodeled homes is risky, even in a limited capacity such as a hot water heater.[56] In home remodeling situations, the utilities and energy sources already available present different approaches for incorporating renewable energy technology, some of which builders may be unfamiliar with.[57] In both of the above scenarios of uncertainty, installers of these systems are a valuable resource, but a gap exists between the homebuilders and installers.

Homebuilders in Vermont

In the context of Vermont, many of those seeking to build a home are often wealthier than the general population, and therefore energy savings from efficiency or a renewable system may not be their top priority.[58] New homes are often second homes for their customers who do not think that incorporating a renewable energy system is worthwhile in a house they may occupy only a few months a year.[59] According to Randi Lawrence from the McKernon group, their status as a "green home builder" is not the primary attraction for their customers, but may give them a competitive advantage over other homebuilders despite their higher cost.[60] While green homebuilders do introduce sustainable and efficient products in the design process and have experienced increased initial client interest in efficiency, there is far less interest in renewable energy technology related to the reasons described above.[61] Despite the fact that many new homebuilders in Vermont cater to a wealthy clientele, many have a hard time justifying the need for additional upfront costs of an expensive renewable energy system when their clients are interested in other luxuries, like a hot tub.[62] While the payback on a renewable system is instant for a homebuilder or installer, it has a much longer rate of return for the homeowner who is actually investing in the technology.[63] For others seeking to build a new home or remodel an existing one while starting with less capital, energy efficiency has a better rate of return than investing in a renewable energy system with greater upfront costs.[64]

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[52] George Lawrence, The McKernon Group (personal communication, November 4, 2004); Cohen-Rosenthal et al, 5.

[53] Cohen-Rosenthal et al, 6; Jamie Hutchins, Oakville Properties (personal communication, November 9, 2004).

[54] John Tenny, Mill Bridge Construction (personal communication, October 29, 2004).

[55] Cohen-Rosenthal et al, 8.

[56] John Straube, Balanced Solutions Inc., (personal communication, November 7, 2004).

[57] Jonathan D. Meyer, Meyer Sons Builders Inc. (personal communication, November 8, 2004).

[58] George Lawrence, The McKernon Group (personal communication, November 4, 2004); John Tenny, Mill Bridge Construction (personal communication, October 29, 2004).

[59] Ibid.

Homebuilders consulted did have some experience with passive solar design and PV arrays on a very limited basis with a few of their more environmentally minded customers.[65] Solar was described as the preferred technology for Vermont because of siting issues related to wind, and lower wind speeds in the Champlain Valley where the homebuilders consulted do most of their work.[66] Misconceptions of how wind turbines work raise safety concerns for clients and their neighbors. Progress in solar and wind technology have helped lower the cost of initial homeowner investment, increase the amount of power produced, and made the systems more user friendly, thus making them a more attractive option than a decade ago.[67] Homebuilders speculated that advancements in aesthetics, such a solar tiles, would also make renewable energy technology more attractive.[68] In summary, homebuilders found that lack of education about how renewable energy technology works was the primary reason why this technology is not used more often in home construction despite advancements in technology and energy savings.

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[60] Randi Lawrence, The McKernon Group (personal communication, November 4, 2004).

[61] George Lawrence, The McKernon Group (personal communication, November 4, 2004); John Tenny, Mill Bridge Construction (personal communication, October 29, 2004).

[62] John Tenny, Mill Bridge Construction (personal communication, October 29, 2004); James Vann, RA Solar Company (personal communication, November 11, 2004); George Lawrence, The McKernon Group (personal communication, November 4, 2004).

[63] Ibid.

[64] George Lawrence, The McKernon Group (personal communication, November 4, 2004).

[65] George Lawrence, The McKernon Group (personal communication, November 4, 2004); John Tenny, Mill Bridge Construction (personal communication, October 29, 2004).

[66] Ibid.

[67] George Lawrence, The McKernon Group (personal communication, November 4, 2004); John Tenny, Mill Bridge Construction (personal communication, October 29, 2004).

Part IV: Homeowners

After speaking to several homeowners who employ RE through both grid connected and off grid systems, it is apparent that there are a number of advantages and disadvantages to these systems recognized across the board.

Advantages

There are many positive aspects of deciding to live in a home that receives some or all of its power from RE sources. Renewable energy is an environmentally friendly, low impact way to power a home for the same reasons described in the introduction. Even if only a fraction of the energy supply comes from such a device, that energy is less harmful to the environment than the standard kilowatt-hour bought from the local utility. RE systems produce power using resources that cannot be depleted, and contrary to utility power, produce no emissions that are harmful to the environment. RE systems also require little maintenance throughout their lifetime, which give homeowners less to worry about.[69]

Many RE consumers feel a great satisfaction in the fact that their electricity is being created at the site of their home, and seeing where power comes from promotes a greater understanding and awareness of energy consumption.[70] Amy Seidl describes her RE home as a “successful educational experiment for her family,” especially for her 5-year old daughter who has learned at a very early age the importance of energy conservation.[71]

Independence from the utility companies was also mentioned as an advantage by homeowners.[72] The idea of a smaller electricity bill (or in some cases a non-existent one) is an incentive, and the greater personal energy security is a big plus as we come closer to the time when it will be necessary to replace fossil fuels as our primary power source. In times of power outages, RE systems with battery storage capabilities can supply power beyond what is created at that moment. For other non-battery systems, given proper climatic conditions (wind, sun, etc.), power will be available as it is produced. In addition to this security during power outages, off-grid homes often have backup generators, which prevent costly damage such as frozen pipes from occurring due to power loss.

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[68] Ibid.
[69] Zach Sachs, homeowner (personal communication, October 30, 2004).
[70] David Palumbo, Independent Power (personal communication, November 8, 2004).
[71] Amy Seidl, homeowner (personal communication, December 6, 2004).
[72] Jamie Hutchins, Oakville Properties (personal communication, November 9, 2004).

Renewable energy technology also allows for energy in remote areas, where it would be costly to bring in utility power, which raises the interest of builders and buyers. Amy Seidl relayed how it would have cost her family twice as much to bring in the power grid than it did to install a hybrid solar and wind system.[73] While expensive to begin with, in the long run they will more than pay for themselves.

Drawbacks and Complications

The major complaint with RE systems is power storage in off-grid homes. Amy Seidl described her desire to store excess energy produced during the very sunny summer months over the long term so that power can be used in the winter when there is little sun. During those times, her family must rely heavily on their backup generator to compensate for the power their RE system is unable to produce.[74] Other than power storage, major disadvantages dealt with problems unrelated to the RE system mechanics.

There are several obstacles that stand in the way of either purchasing an RE home or adding RE to a home. As explained in the financing section, it is often hard to get a mortgage for an RE home. While financing for RE systems is possible, high upfront cost is a major deterrent for homeowners in purchasing RE systems. Pay back time for RE setups is often longer than the standard homeowner stays in one place. From a financial standpoint, if the payback time is twenty years, and the average homeowner moves in five, then RE systems are not wise investments.[75] Before making a large financial commitment to a home that will not necessarily raise the appraised value of the home, it makes sense that one would want to be committed to living in that location.

Obtaining permits is not too complicated, but is made problematic by objecting neighbors. This is more of an issue with wind than solar, with many objections stemming from aesthetics and a lack of understanding of RE systems. George Lawrence mentioned instances where new homeowners will call installers asking for a solar hot water heater or some other RE to be removed, usually stemming from a lack of understanding of what "the thing in the basement" is.[76] Over time, as the general public becomes more educated about the possibilities and advantages of RE, perceptions are likely to change, which will make the process easier. The trick is getting to this point.

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[73] Amy Seidl, homeowner (personal communication, December 8, 2004).
[74] Amy Seidl, homeowner (personal communication, December 8, 2004).
[75] George Lawrence, The McKernon Group (personal communication, November 4, 2004).

Conclusions and Next Steps

Increasing the marketability of renewable energy technology by staying the course of progress while making the technology more attractive is the biggest challenge for the RE technology industry. As more renewable energy systems are incorporated in residential homes and commercial developments, industry familiarity and lower prices may lead to increased installation.[77] However, this process needs to be kick-started by an incentive program, and more education about the benefits of RE through better marketing. Education campaigns about how renewable energy technology works and its benefits, both for homeowners and the environment, will help Vermont move towards a greater supply of clean energy in our energy mix as well as improving the state economy and energy security. In order for this to occur, support from the state and federal government is necessary. While there are programs that exist on multiple levels, they need to be better publicized so that more Vermonters take advantage of them, thus realizing the growing need, accessibility and desirability of this technology.

Our research has uncovered many opportunities for and barriers to incorporating RE technology in the financing and permitting process, and we have gained many insights from installers, homebuilders, and homeowners. In order to optimize the use of RE technology in residences throughout Vermont, actions need to be taken to advance the understanding and acceptance of this technology. We recommend the following actions:

- There are resources available for homebuilders to learn about renewable energy technology through green building associations and sustainable energy groups. A conference similar to the Northeast Sustainable Energy Association's "Building Energy Conference" for Vermont homebuilders and RE installers would increase the business connections between these two industries while serving primarily to educate homebuilders about the advantages of renewable energy incorporation in new and renovated homes.[78] A similar event for Vermont homebuilders and RE installers would greatly benefit both parties by raising awareness of the great potential for RE technology and establishing business connections. Greater education about already existing directories of RE installers and green homebuilders would help bridge the gap between homebuilders and installers.[79] If installers and homebuilders started to work together more regularly, this would undoubtedly lead to a greater supply of RE technology in new homes, as RE would at least be given as an option. Renewable technologies would become, like green building, not the lowest cost option but advantageous for other reasons, making it appealing to homeowners.

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[76] George Lawrence, The McKernon Group (personal communication, November 4, 2004).
[77] Cohen-Rosenthal et al, 8.

- Education can also be achieved through a Building Vermont program modeled on the Department of Energy's Building America program. By working as research teams with installers, homebuilders would gain hands on experience with RE and incorporate this technology to a greater degree in their own work.[80] Building for Social Responsibility, a program of the Vermont Energy Investment Corporation, would be a good partner for the Building America and Building Energy models because of their existing renewable energy partners and Vermont Builds Greener Scorecard, which sets standards for residential home green design.[81]
- Refunding the incentive program will likely encourage homeowners to consider incorporating RE technology into their homes. By providing an accessible source of funding for homeowners to purchase RE systems, the incentive program will enable greater use of this technology, and will help Vermont's economy by

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[78] Northeast Sustainable Energy Association Building Energy, "Building Energy" (http://www.nesea.org/buildings/be/, accessed November 13, 2004).

[79] Source Guides, "Solar Electric Power System Businesses in Vermont" (http://energy.sourceguides.com/businesses/byGeo/US/byP/solar/solectric/byS/VT/VT.shtml, accessed November 14, 2004); Efficiency Vermont, "Residential Marketplace" (http://www.efficiencyvermont.com/index.cfm?L1=141&L2=410&sub=res, accessed November 15, 2004); Energy Efficiency Division of the Vermont Department of Public Service, "Vermont Renewable Energy Business Directories" (http://www.state.vt.us/psd/Menu/EE_and_Renewable/ee16.htm, accessed November 15, 2004).

[80] U.S. Department of Energy, "Building America" (http://www.eere.energy.gov/buildings/building_america/, accessed November 11, 2004).

[81] Building for Social Responsibility (http://www.bsr-vt.org/homepage.html, accessed November 12, 2004).

providing more business for RE installers. For more information on homeowner incentive programs, see Vermont Homeowner Renewable Energy Incentives: Towards An Effective Incentive Strategy.

- Changes in building codes in favor of renewables could make future use of RE technology possible. For example, wiring existing structures for future use of RE technology will make it easier for homeowners to change their energy supply. Builders tend to build to building codes, and changing these codes may prompt builders to rethink their practices.[82]
- It is important for state and town officials to support construction of public and commercial buildings with renewable energy technology. By seeing renewable energy in action, general public trust in the technology will increase and individuals intrigued by this technology may be more likely to research how it can benefit them in their own homes.
- Development of economic models to help homeowners predict what their energy costs will be based on realistic future fuel prices and availability projections can help homeowners plan for the long term, and allow them to see how renewable energy technology may help them save on energy costs.[83]
- Power companies and the Public Service Board should continue to make net metering possible for residential homeowners. Home power generation is by nature contrary to power company profit motives. Although several power companies in Vermont have expressed their commitment to renewable energy, loss of customers due to increased home production may be a threat to their business.
- Continue research and development of both wind and solar technology to lower the costs of these systems, thus making them more affordable to the general population.[84]

While our research uncovered many aspects of incorporating RE in homes, we identified several areas in need of additional research as follows.

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[82] Cohen-Rosenthal, 11.
[83] Keith Dewey AIA, Dewey & Associates Architects & Planners (personal communication, November 11, 2004).
[84] Ibid.

- A more comprehensive study related to individual town zoning regulations would benefit homeowners interested in installing RE systems. Providing homeowners with the list of the steps they need to follow for their own town will be a great resource. This would also help installers around the state, many who go through the permitting process with their clients. Although most towns have limited regulations of renewable energy technology, new language may emerge from on-going town plan reviews. Simply making RE an official part of zoning and permitting regulations would clarify how neighbor conflicts should be resolved.
- Homeowner insurance and the real estate market are two issues associated with this topic that could also use some investigation. The issue of insurance came up when speaking to a number of bankers, who say insurance can be hard to get for remote homes due to the hazard of having no nearby fire hydrants.[85] On a different but related note, it would be interesting to learn if real estate agencies are willing to list these properties, or if they too see them as risky and hard to sell. Gather more perspectives on renewable energy technology from realtors and insurance agencies will further elucidate the problems associated with the financial aspect of RE in homes.

In conclusion, most of the barriers are related to cost and attitudes. It is consumer attitudes that drive what is being built, neighbor attitudes that slow permitting, and what is available on the market that shapes financing. Given the interconnected nature of the markets that need changing, when one part begins to shift, the others will follow, or be left behind. If the steps outlined above are taken into consideration, and other educational and incentive programs are put into place, renewable energy is likely to become prevalent in Vermont at a faster rate, which will in turn force lenders to create better options for homeowners.

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[85] Mark O'Connell, Statewide Mortgage Assistance (personal communication, November 16, 2004).

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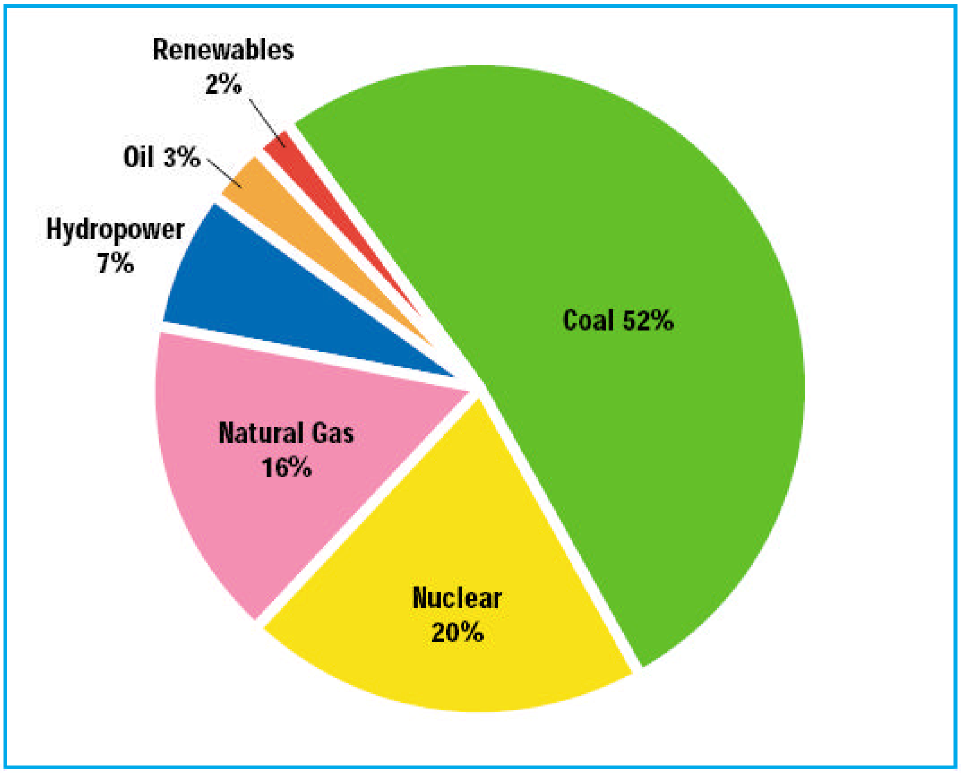
Appendix A: Energy Mix Charts

Figure 1. US Energy Mix in 2000

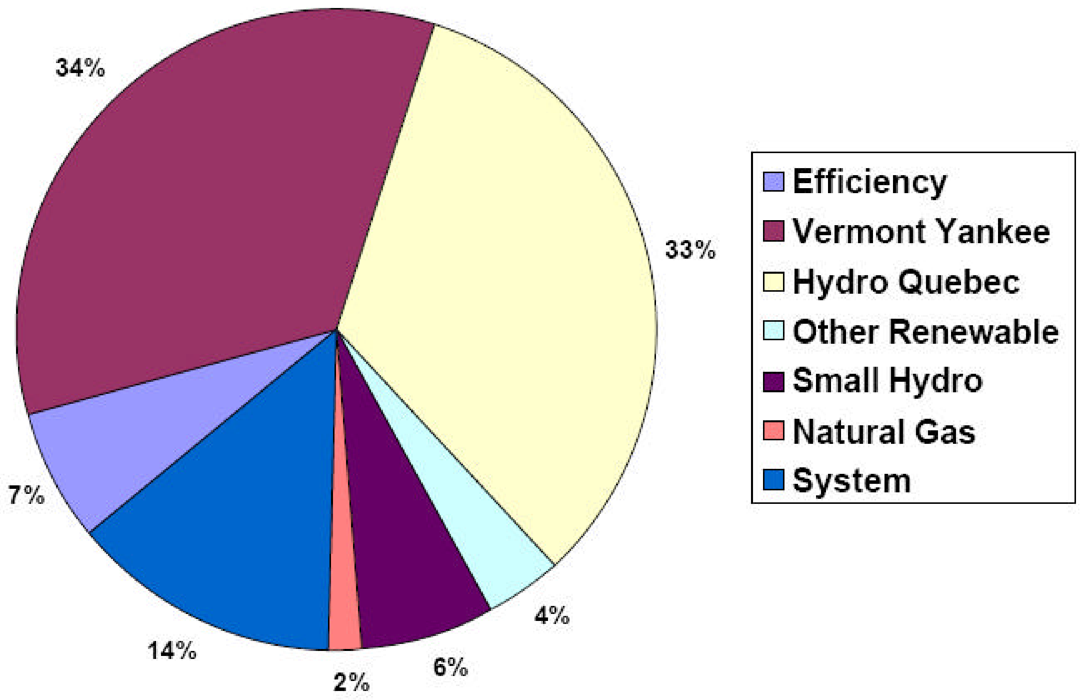


Electricity is a secondary source of energy, generated through the consumption of primary sources. Coal and nuclear energy account for nearly 75 percent of U.S. electricity generation.

Source: U.S. Department of Energy, Energy Information Administration

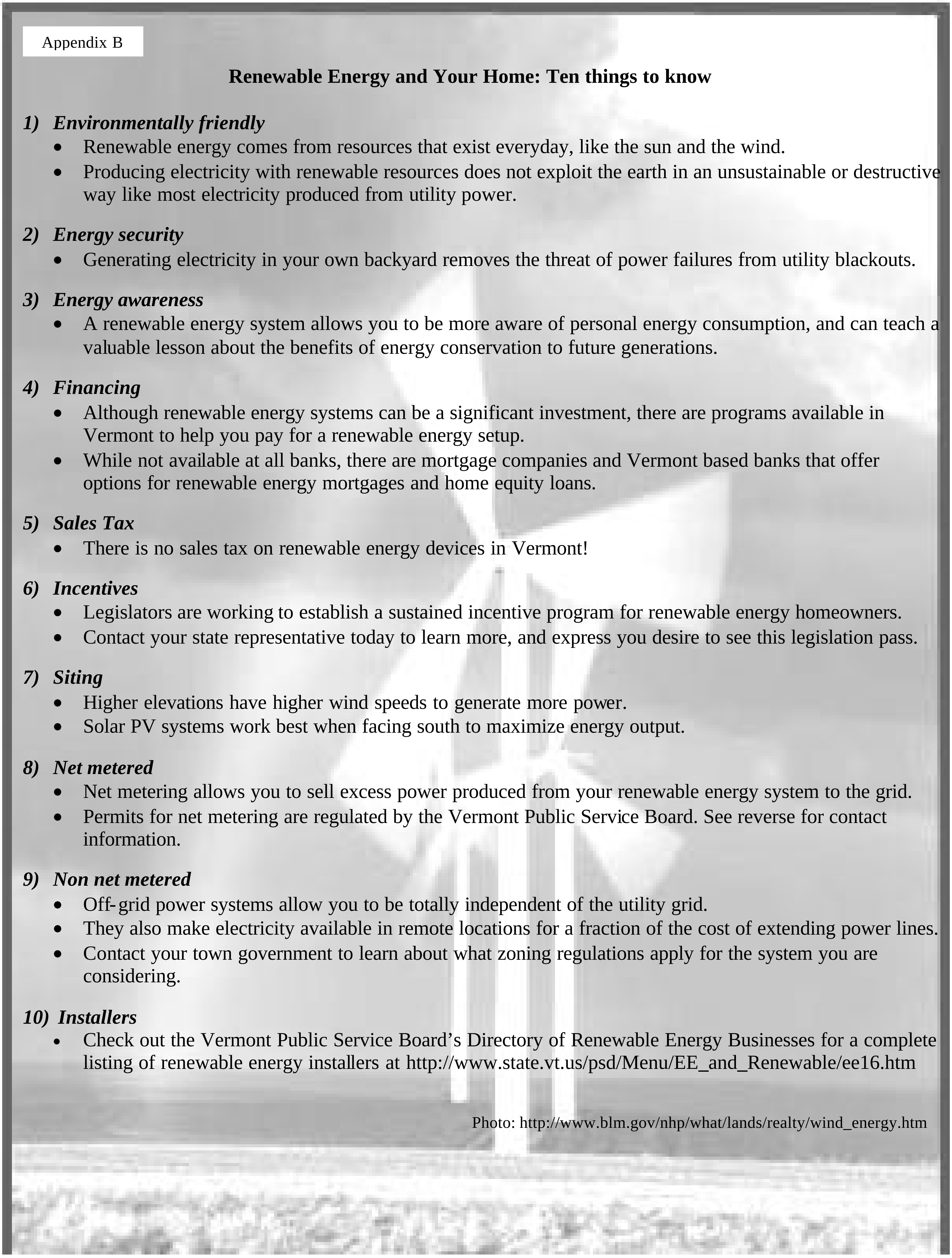
From National Energy Policy Development Group, *National Energy Policy* (Washington, DC: Office of the Vice President, May 2001) xiii, (http://www.whitehouse.gov/energy/Overview.pdf, accessed 12/14/04).

Figure 2. Vermont's 2004 Energy Mix



From Azur Moulaert & Drew Hudson, *Clean Energy for Vermont: A Plan Today for Tomorrow* (Montpelier, Vermont: Vermont Public Interest Research and Education Fund, 2004) 25, (http://www.vpirg.org/downloads/2004.08.27_Clean_Energy_for_Vermont_final_version.pdf, accessed 12/14/04).

Appendix B



Renewable Energy and Your Home: Ten things to know

1) ***Environmentally friendly***
   - Renewable energy comes from resources that exist everyday, like the sun and the wind.
   - Producing electricity with renewable resources does not exploit the earth in an unsustainable or destructive way like most electricity produced from utility power.

2) ***Energy security***
   - Generating electricity in your own backyard removes the threat of power failures from utility blackouts.

3) ***Energy awareness***
   - A renewable energy system allows you to be more aware of personal energy consumption, and can teach a valuable lesson about the benefits of energy conservation to future generations.

4) ***Financing***
   - Although renewable energy systems can be a significant investment, there are programs available in Vermont to help you pay for a renewable energy setup.
   - While not available at all banks, there are mortgage companies and Vermont based banks that offer options for renewable energy mortgages and home equity loans.

5) ***Sales Tax***
   - There is no sales tax on renewable energy devices in Vermont!

6) ***Incentives***
   - Legislators are working to establish a sustained incentive program for renewable energy homeowners.
   - Contact your state representative today to learn more, and express you desire to see this legislation pass.

7) ***Siting***
   - Higher elevations have higher wind speeds to generate more power.
   - Solar PV systems work best when facing south to maximize energy output.

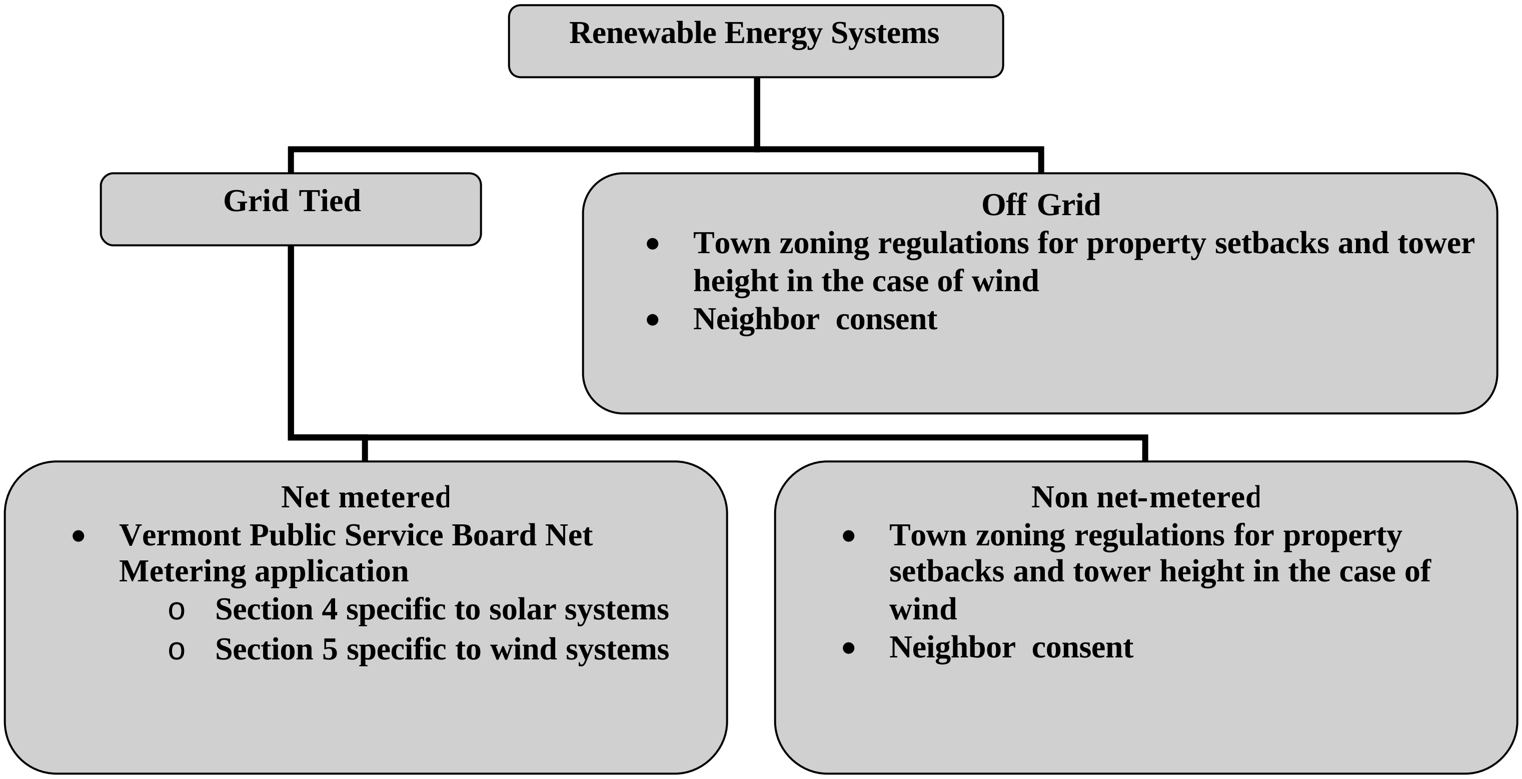
8) ***Net metered***
   - Net metering allows you to sell excess power produced from your renewable energy system to the grid.
   - Permits for net metering are regulated by the Vermont Public Service Board. See reverse for contact information.

9) ***Non net metered***
   - Off-grid power systems allow you to be totally independent of the utility grid.
   - They also make electricity available in remote locations for a fraction of the cost of extending power lines.
   - Contact your town government to learn about what zoning regulations apply for the system you are considering.

10) ***Installers***
   - Check out the Vermont Public Service Board’s Directory of Renewable Energy Businesses for a complete listing of renewable energy installers at http://www.state.vt.us/psd/Menu/EE_and_Renewable/ee16.htm

Photo: http://www.blm.gov/nhp/what/lands/realty/wind_energy.htm

The Paths of Permitting



Renewable Energy Systems

Grid Tied

Off Grid
- **Town zoning regulations for property setbacks and tower height in the case of wind**
- **Neighbor consent**

Net metered
- **Vermont Public Service Board Net Metering application**
  - **Section 4 specific to solar systems**
  - **Section 5 specific to wind systems**

Non net-metered
- **Town zoning regulations for property setbacks and tower height in the case of wind**
- **Neighbor consent**

Additional Resources

- Chittenden Bank. Socially Responsible Banking. https://www.chittenden.com/socially-responsible.html
- Cohen-Rosenthal, Ed et al. "Build it Right: Cleaner Energy for Better Buildings," *Renewable Energy Policy Project with American Council for an Energy-Efficient Economy Research Report 10.* Washington, DC: Renewable Energy Policy Project, March 2000: 10 http://solstice.crest.org/repp_pubs/pdf/buildings2.pdf
- Database of State Incentives for Renewable Energy. http://www.dsireusa.org/
- Department of Energy and the Environmental Protection Agency, "Energy Star Qualified New Homes" March 2000. http://energystar.gov/index.cfm?c=new_homes.hm_index
- Efficiency Vermont. http://www.efficiencyvermont.com
- Merchants Bank. http://www.mbvt.com/
- The Renewable Energy Resource Center: A project of the Vermont Energy Investment Corporation. http://www.rerc-vt.org
- U.S. Department of Energy. *The Borrowers Guide to Financing Solar Energy Systems: A Federal Overview.* Second Edition. March 1999. http://www.nrel.gov/ncpv/pdfs/26242.pdf
- Vermont Energy Investment Corporation. http://www.veic.org
- Vermont Public Service Board. *Net Metering Application.* http://www.state.vt.us/psb/rules/5100amendedappanoheader.pdf

Created by Caitlyn Long and Clare O'Reilly, Middlebury College, ES401, Fall 2004

Appendix C: Vermont Renewable Energy Installation Companies

* indicates information from the company was included in our report

Company	Phone/email/websites	Renewable catagories
Atlantic Orient Corporation Farrell Farm Road, Rt. 5 N. Norwich, VT 05005	(802) 649-5446 mmacinnis@aocwind.com www.aocwind.net	Wind
Bast and Rood, Architects PO Box 220, Hinesburg, VT 05461	(802) 482-5200 (802) 482-3953 bastrood@together.net	Passive solar design
Better World Workshop 1915 E. Hill Rd. Marshfield, VT 05658	456-8993 Srogs@aol.com	Biomass
Black River Design 73 Main St., Montpelier, VT 05602	(802) 223-2044 (802) 223-1132	Passive solar design
Blake Spencer, Builder 188 Justin Morrill Hwy, Strafford, VT 05072	(802) 765-4490 (802) 765-4490	Passive solar design
BPVS 169 Magee Rd., Stamford, VT 05352	413-743-0152 cdkbpvs@sover.net	Solar Wind
Central Vermont Solar and Wind 213 N. Main (RT 7), Rutland, VT 05701	(802) 747-0577 (802) 773-0924 cvsolar@aol.com www.cvsolar.com	Solar Wind Passive solar design
Central Vermont Solar and Wind 200 West Rd., N. Chittenden, VT 05763	(802) 747-0577 (802) 483-6233 cvsolar@aol.com www.middlebury.net/cvsolar	Wind Solar
CET Solar Store, LLC 65 Route 106 North Springfield, VT 05150	cetsolar@vermontel.net www.cetsolar.com	Solar
Chiptec Wood Energy Systems 48 Helen Avenue S. Burlington, VT 05403	658-0956 chiptec@together.net www.chiptec.com	Biomass
Chimney Sweep 3113 Shelburne Rd. Shelburne, VT 05482	985-4900	Biomass
Chimney Sweep Two 1284 US RT 302 Berlin St. Suite 10 Barre, VT 05641	476-4905	Biomass
CIFCO 34 Frost Place, Brattleboro, VT 05301	(802) 254-4591 (802) 254-7677	Solar
Jeremy Coleman Architecture & Planning 111 Main St. Brattleboro, VT 05301	(802) 257-1950 (802) 254-2568 jcoleman@sover.net	Passive solar design
Cumulus Engineering 1619 Frosty Lane Bridport, VT 05734	(802) 758-2287 paulkenyon@juno.com	Wind
Cushman + Beckstrom Inc. Architecture and Planning PO Box 655 Stowe, VT 05672	(802) 253-2169 (802) 253-2160 design@cbap.net	Passive solar design

Dewey + Associates, Architects* PO Box 612, Londonderry, VT 05148-0612	(802) 828-5612 (802) 829-3936 deweyaia@sover.net	Passive solar design
John Q. Doane Architiect 1 Grove Street, Essex Junction, VT 05452	(802)879-3091 (802)872-7790 doane@together.net	Passive solar design
Draker Solar Design, LLC P.O. Box 8346 Burlington, VT 05402	(802) 238-2964 (802) 657-3731 logan@drakersolar.com www.drakersolar.com	Solar
Echelon Environmental Energy 59 Spruce St. Bulington, VT 05401	(802) 660-9463 echelonenergy@excite.com	Wind
Edgecomb Design Group RR 1 Box 113, Warren, VT 05674	(802) 496-2165 (802) 496-2166	Passive solar design
Elmer Construction & Design 208 Stone Farm Rd., Marshfield, VT 05658	(802) 563-2035	Passive solar design
Elemental Energy 1750 Clark Rd., E. Montpelier, VT 05651	(802) 476-3441 (802) 476-3441 iggrundy@aol.com	Solar Wind
Energy Balance, Inc. 45 Perkins Road, Montpelier, VT 05560	(802) 229-5676	Solar Passive solar design
Four Seasons Sun Rooms PO Box 8304, Brattleboro, VT 05304	(802) 258-6565 (802) 258-9809	Solar Passive solar design
Friends of the Sun 671B Depot St., Route 11/30 Manchester Center, VT 05255	362-4070 800 639-2603 hotstuff@friendsofsun.com www.friendsofsun.com	Biomass
Glassworks PO Box 206, Waterbury, VT 05676	(802) 244-5449 (802) 244-593	Passive solar design
Global Resource Options, LLP PO Box 51, Strafford, VT 05072	(802) 765-4632 (802) 765-9983 800-374-4494 global@sover.net www.globalresourceoptions.com	Solar Wind
Gossens Bachman Architects 85 Granite Shed Lane, Montpelier, VT 05602	(802) 229-1664 (802) 229-4822	Solar
Guillot-Vivian-Viehmann Architects Inc. 284 S. Union St., Burlington, VT 05401	(802) 862-9631 (802) 660-9010 fguillot@together.net http://together.net/~fguillot/fga.htm	Passive solar design
Hearth & Cricket Rts. 140 & 155 E. Wallingford, VT 05742	259-2841 daryleone@aol.com www.rutlandherald.com/hearthandcrick	Biomass

Independent Power & Light* 462 Solarway Drive, Hyde Park, VT 05655	(802) 888-7194 (802) 888-4230 indeppower@aol.com www.independent-power.com	Solar
Indiana Architecture & Design 477 Ten Stones Circle, Charlotte, VT 05445	(802) 425-7717 (802) 425-7717 indarch@sover.net www.sover.net/~indarch	Passive solar design
KAB Enterprises, Inc. 2832 East Hill Road Plainfield, VT 05667	(802) 454-1321	Biomass
Keefe & Wesner Architects, P.C. PO Box 367, N. Bennington, VT 05257	(802) 447-1724 (802) 447-7580 keefewes@sover.net www.keefeandwesner.com	Passive solar design
Little Village Sustainble Living Center Center 147 North Main St. Rochester, VT 05767	(802) 767-9999 www.vermontsolarliving.org mail@vermontsolarliving.org	Solar Wind
Maclay, William Architects & Planners 4509 Main St., Waitsfield, VT 05673	(802) 496-4004 (802) 496-4007 wmap@wmap-aia.com www.wmap-aia.com	Passive solar design
John Mallery, Architect & Builder 108 Norton Road, Worcester, VT, 05602	(802) 223-1500 johnmallery@hotmail.com	Passive solar design
Montpelier Stove Works 178 River Street Montpelier, VT 05602	(802) 229-0150 800-287-0150	Biomass
Montpelier Stove Works 3762 Shelburne Rd. Shelburne, VT 05482	(802) 985-8280	Biomass
New England Geothermal Systems P.O. Box 636 Putney, VT	(802) 258-6504 (802) 463-2232 info@negeothermal.com www.negeothermal.com	Geothermal
Northern Architects, Inc. 207 King Street, Burlington, VT 05401	(802) 658-1953 (802) 658-2975 northarch@aol.com	Passive solar design
Northern Power Systems PO Box 999, Waitsfield, VT 05673	(802) 496-2955 (802) 496-2953 www.northernpower.com	Solar Wind
NRG Systems, Inc. 110 Riggs Road Hinesburg, Vermont 05461	T: (802)482-2255 F: (802)482-2272 www.nrgsystems.com	Wind
Oak Ridge Alternative Energy Hamond Hill Rd., Brownsville, VT 05089	(802) 674-9236 Syrinx21@aol.com	Solar Wind Quit last year

Patullo Consulting Inc. 107 Cherry Lane, Burlington, VT 05401	(802) 660-8903 (802) 660-8903 sunergy@together.net	Solar Passive solar design
Sam Daniels PO box 868 Montpelier VT 05601	223-2801	Biomass
Solar Applications Company 22 S. Main St., Brattleboro, VT 05301	(802) 257-7493	Solar Wind Passive solar design
Solar Works, Inc. 64 Main St., Montpelier, VT 05602	(802) 223-7804 (802) 223-8980 info@Solar-Works.com www.solar-works.com	Solar Wind
South Face Design & Construction PO Box 82, Brownsville, VT 05037	(802) 484-3307 (802) 484-3307 soface@sover.net www.sover.net/~soface	Solar Passive solar design
Specialized Power Systems, Inc. 30 Depot Road Hartland, VT 05048	[illegible] call first) (802) 436-2463 or 877-806-4221 info@specializedpowersystems.com www.specializedpowersystems.com	Solar
Spectacle Technology PO Box 114, E. Calais, VT 05650	(802) 456-7097 scheckel@sover.net www.spectacletech.com	Solar
Sunlight Electric 2257 Lightening Ridge Rd. Plainfield, VT 05667	(802) 454-8020 sunlight@plainfield.bypass.com	Solar
Sunnyside Solar, Inc. 1014 Green River Road, Guilford, VT 05301	(802) 257-1482 (802) 254-4670 sunnysde@sover.net www.sunnysidesolar.com	Solar
Sunrise Solar Services PO Box 129, Randloph, VT 05060	(802) 728-6510 (802) 728-6510 sunsol@sover.net	Solar
Sustainable Solutions 170 Lafirira Pl. Marshfield, VT 05658	(802) 426-3556 sunsol@sover.net	Solar
Vermont Castings PO box 501 Bethel, VT 05032	234-2300	Biomass
Associates (VERA) 1209 Harvey Farm Road Waterbury Center, VT 05677	(802) 244-7522 (802) 244-1857 vera@northeastwind.com www.northeastwind.com	Wind
Vermont Green Energy Systems*	(802) 388-4334 (802) 388-4334 thalnon@sover.net	Wind Solar

Vermont Solar Engineering* PO Box 697 Burlington, VT 05402	(802) 863-1202 & (800) 286-1252 (802) 863-7908 sales@vtsolar.com www.vtsolar.com	Solar Wind
Vermont Sun Structures 206 Walker Hill Road Williston, VT 05495	(802) 879-6645 (802) 879-4144	Solar
Michael Weinberger Associates 79 Pleasant St., Woodstock, VT 05091	(802) 457-1866 (802) 457-4649	Passive solar design
Williams & Frehsee, Inc. 7 Holstein Place, Brattleboro, VT 05301	(802) 257-1311 (802) 257-9429 jim@wfivt.com	Passive solar design
WindstreamPower Systems, Inc.* PO Box 1604, Burlington, VT 05402	(802) 658-0075 (802) 658-1098 info@windstreampower.com www.windstreampower.com	Solar Wind
Yestermorrw Design/Build School RR Box 97-5, Warren, VT 05674	(802)496-5545 (802) 496-5541 designbuild@yestermorrow.org www.yestermorrow.org	Passive solar design